



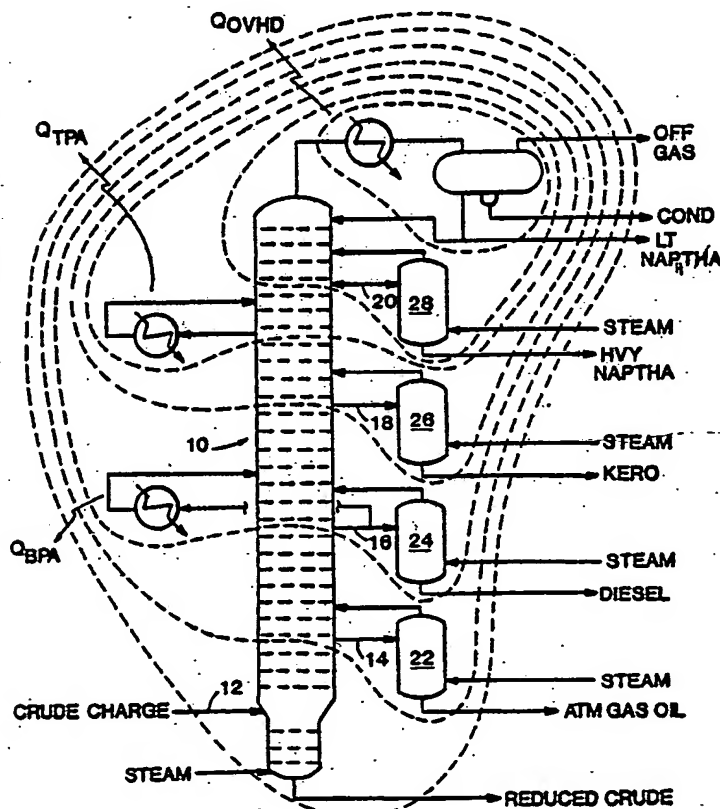
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(54) Title: DISTILLATION CUT POINT CONTROL

(57) Abstract

Control of crude oil distillation columns. In particular, properties of the liquid in the bottom tray of a side stream stripping unit (22) associated with the crude distillation column (10) are monitored in order to control product draw rates thereby maintaining desired product cut points. Preferably, partial pressures and initial boiling points of the equilibrium flash vaporization curve ("IBP/EFV") are monitored in this control Scheme.



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DISTILLATION CUT POINT CONTROLField of the Invention

This invention relates to removal of cuts from mixtures of liquids, and more particularly to cut point control in petroleum crude towers.

Background of the Invention

It has been known to correlate side draw temperatures with cut points through simultaneous monitoring of numerous tower parameters (e.g., Nelson, "Petroleum Refinery Engineering", McGraw-Hill, Fourth Ed. 1958, 473 ff).

Summary of the Invention

I have discovered that the cut point between any heavier cut to be withdrawn and lighter material may be controlled based on parameters around simply the bottom tray of a stripper for said heavier cut.

In particular, I have discovered that said cut point may be controlled through use of a characteristic of the liquid in said bottom tray.

In a preferred embodiment, said characteristic is the partial pressure of said liquid.

In a further preferred embodiment, said characteristic is the initial boiling point of the equilibrium flash vaporization curve ("IBP/EFV") of said liquid at atmospheric pressure.

By "cut point", I mean that temperature (in °F) on a true boiling point ("TBP") curve (i.e., a batch process curve of percent of mixture--e.g., crude oil--removed in a heavily refluxed tower versus temperature reached to achieve that removal at which a predetermined degree of separation is reached).

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Preferred Embodiment

I turn now to a description of the drawings,
and of a preferred embodiment of the invention.

Drawings

5 Fig. 1 is a diagrammatic view with respect to
practice of the method.

 Fig. 2 is a pair of curves intersecting to give
a cut point.

Steps

10 A crude tower of conventional arrangement, as
shown in Fig. 1, and indicated generally at 10, and con-
taining about fifty plates, was continuously supplied
with heated crude oil through line 12. Emerging from
tower 10 in order up its height were draw lines 14 (for
15 atmospheric gas oil), 16 (for diesel oil), 18 (for kero-
sene), and 20 (for heavy naphtha). Said draw lines fed
respectively into strippers 22, 24, 26, and 28 above the
top plate of each thereof (each stripper having about six
plates).

20 It was decided in advance that composition rang-
es desired to be manufactured would call for cut points
between the atmospheric gas oil and diesel oil of 704°,
between diesel oil and kerosene of 492°, and between
kerosene and heavy naphtha of 322°. My invention was
25 used to maintain and control at these predetermined cut
points (all temperatures mentioned in this document
Fahrenheit) each of the three.

 The invention may be explained in particular
detail with respect to the cut point between diesel oil
30 and kerosene.

 At startup, temperature in the draw tray from

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which draw line 16 emerged was monitored until about that expected to be associated with the desired cup point, about 515°.

My control method was then used to regulate actual cut point.

The following measurements were taken, then, each minute:

- (1) Steam flow to stripper 24 (lbs./hr.)
- (2) Diesel oil flow from bottom of stripper 24 (barrels/day)
- (3) Temperature in diesel oil draw line 16
- (4) Temperature of diesel oil flowing from bottom of stripper 24
- (5) Pressure in stripper 24 (treated as that at draw tray from which draw line 16 emerges, and determined by interpolating between bottom and top pressures of tower 10)

(6) Temperature of steam into stripper 24

(7) Pressure of steam into stripper 24.

- Using these seven measurements, together with constants from laboratory data to give specific heat, partial pressure of diesel oil ("liquid") in the vapor above the bottom plate of stripper 24 is obtained; this is then used to determine atmospheric pressure IBP/EFV of the diesel oil.
- In making this determination, constants are desirably used which from most recent (usually daily) laboratory data update the apex of the two-phase region triangle defined by plotting EFV's for various vaporization percentages as shown in Fig. 3B3.1 of API Technical Data Book (August, 1963), pressure versus temperature graphs for each percentage mixture being a straight line. (Since partial

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pressure of the diesel oil and the temperature of the diesel oil on the bottom tray of stripper 24 define one point on the initial boiling point--i.e., 100% liquid, "IBP"--line and the apex the other, the atmospheric IBP/EFV may be easily picked off.)

Once daily the laboratory supplied an ASTM curve of temperature versus percent vaporized, for both the diesel oil and the kerosene. Using conventional conversions, these permitted establishment of true boiling point curves for each. Using these, plotted over widths reflecting their relative volumes (barrels/day), and with kerosene curve flipped, all as shown in Fig. 2, an intersection results at a temperature which is the cut point.

The difference between this temperature and the IBP/EFV temperature gives a correction factor that may be used with the IBP/EFV temperature to provide the running (minute by minute) cut point.

If the measured cut point is not exactly that desired, the flow rates in draw lines 16 and 18 are appropriately varied, in equal but opposite amounts.

In the same manner, the cut point between atmospheric gas oil and diesel oil was controlled using stripper 22 as the focus of control in the same way as was stripper 24 in the control above described, and, in the same way, the cut point between kerosene and heavy naphtha was controlled using stripper 26 as the focus of control. The cut point between heavy naphtha and light naphtha was controlled by prior art methods, although the method of my invention could of course have been used.

Claims

Other embodiments of the invention within the

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following claims will occur to those skilled in the art.

I claim:

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1. The method of controlling the content of a draw from a distillation column which comprises monitoring a characteristic of contents of a stripper downstream of a draw.
- 5 2. The method of claim 1 in which said contents is that being withdrawn from said stripper.
3. The method of claim 1 in which said characteristic is the partial pressure of liquid on the bottom plate of said stripper.
- 10 4. The method of claim 3 in which another said characteristic is the IBP/EFV of said liquid at atmospheric pressure.
5. The method of claim 4 in which said liquid is a crude oil cut.
- 15 6. The method of claim 3 in which said liquid is a crude oil cut.

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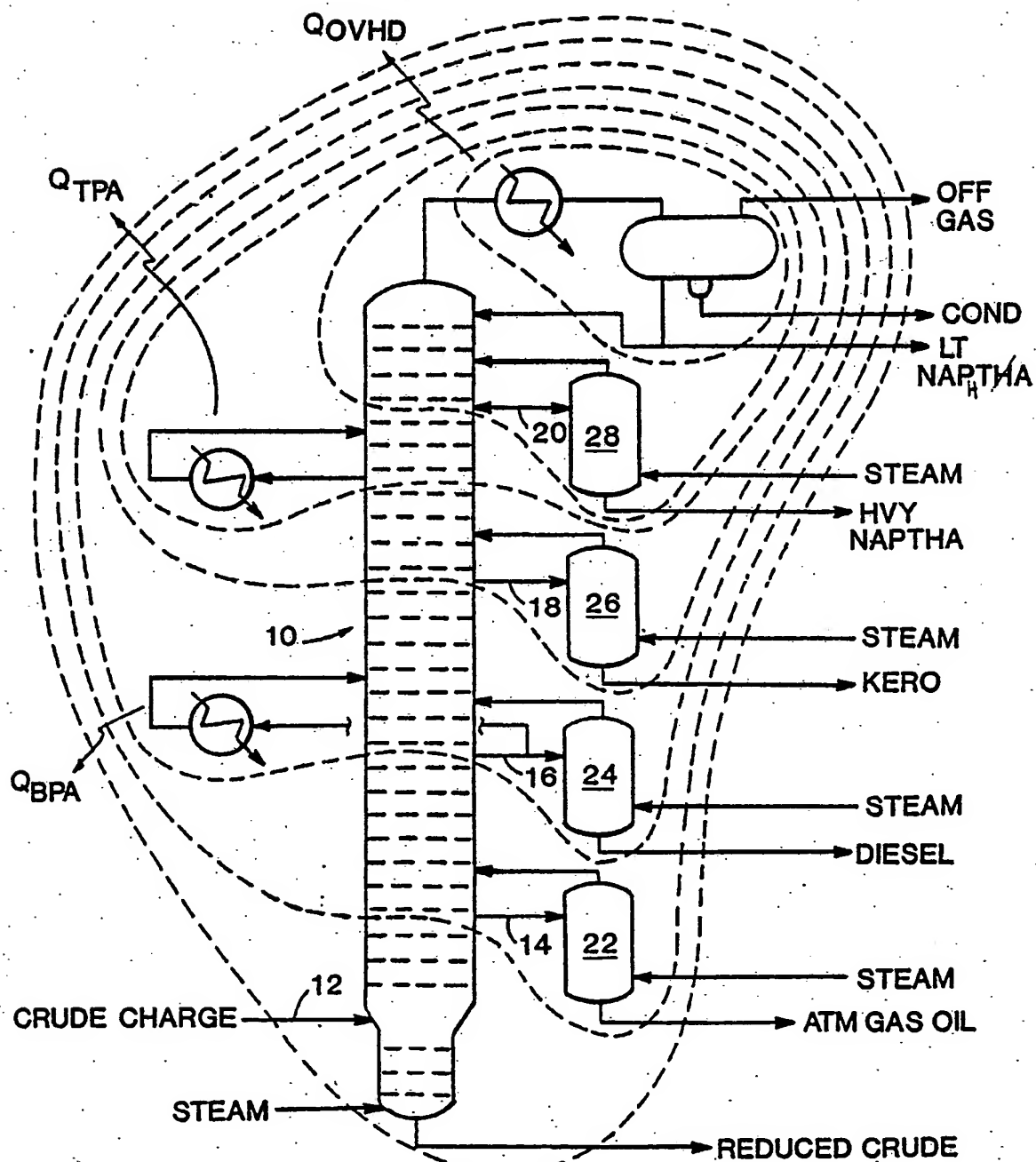


FIG. 1

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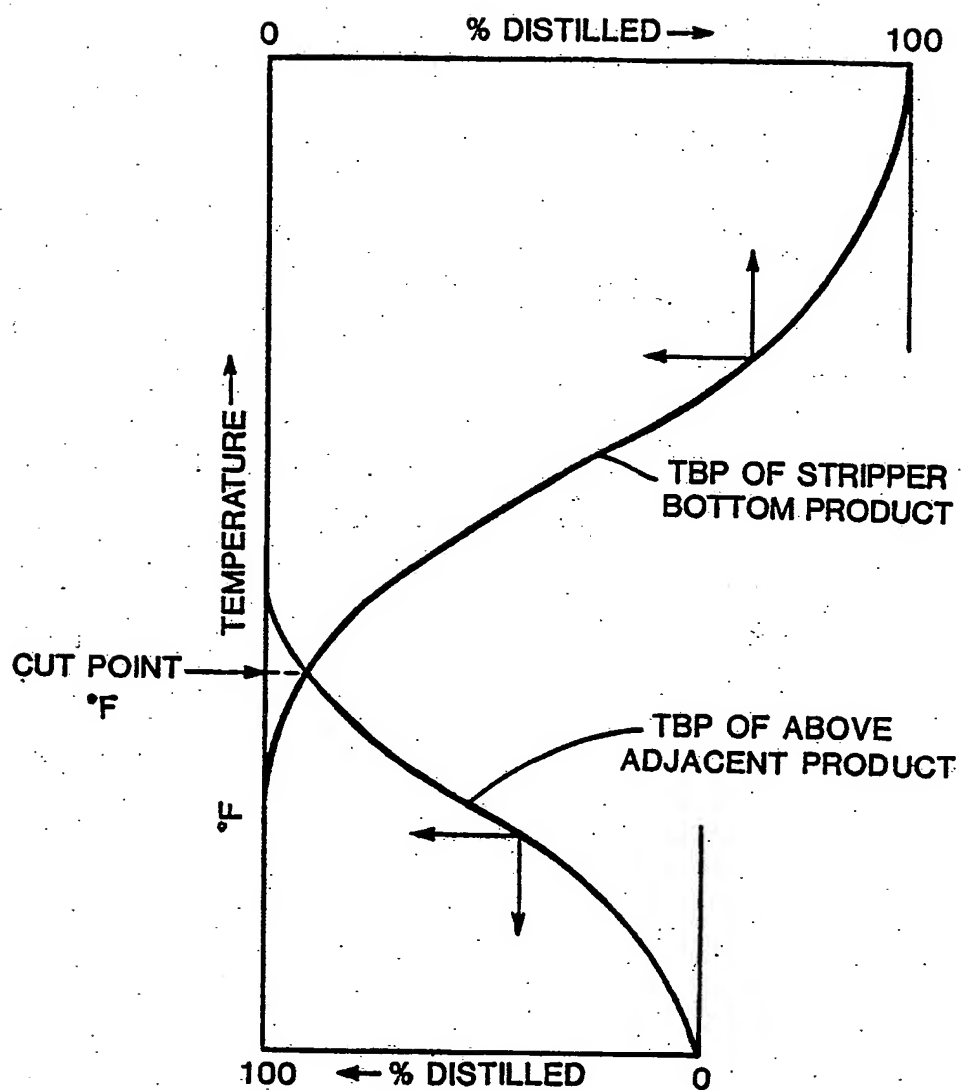


FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No **PCT/US86/00881**

| I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ¹ According to International Patent Classification (IPC) or to both National Classification and IPC Int. Cl. ⁴ C10G 7/12; B01D 3/14 U.S. Cl. 208/347; 208/355; 208/Dig. 1 | | | | | | |
|--|---|--|-----------------------|------------------------|------|---|
| II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Minimum Documentation Searched ⁶</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%; border: 1px solid black; text-align: left;">Classification System</th> <th style="border: 1px solid black; text-align: left;">Classification Symbols</th> </tr> <tr> <td style="border: 1px solid black; vertical-align: top;">U.S.</td> <td style="border: 1px solid black; vertical-align: top;">208/347, 354, 355, 364, Dig. 1 203/1.2.3</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁶</div> | | | Classification System | Classification Symbols | U.S. | 208/347, 354, 355, 364, Dig. 1 203/1.2.3 |
| Classification System | Classification Symbols | | | | | |
| U.S. | 208/347, 354, 355, 364, Dig. 1 203/1.2.3 | | | | | |
| III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴ | | | | | | |
| Category ⁸ | Citation of Document, ¹⁶ with Indication, where appropriate, of the relevant passages ¹⁷ | Relevant to Claim No. ¹⁸ | | | | |
| X Y | US, A, 3,365,386, (Van Pool) 23 January 1968, see especially column 3, lines 22-27. | <u>1,2,5,6</u> 3,4 | | | | |
| Y | Edminster, "Applied Hydrocarbon Thermodynamics" Published 1981, Gulf Publishing Co, USA, see pages 116-132. | 3,4 | | | | |
| A | US, A, 3,320,158, (Potts) 16 May 1967. | | | | | |
| <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>¹⁵ * Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div> | | | | | | |
| IV. CERTIFICATION | | | | | | |
| Date of the Actual Completion of the International Search ¹ 11 July 1986 | | Date of Mailing of this International Search Report ² 24 JUL 1986 | | | | |
| International Searching Authority ¹ ISA/US | | Signature of Authorized Officer ¹⁰ Glenn A. Caldarola | | | | |